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Applicants:	T. KUTSUNA, et al.
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Title:	FUEL SYSTEM HAVING EXCELLENT GASOLINE BARRIER PROPERTY
Group AU:	1772
Examiner:	Marc A. Patterson
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REQUEST FOR RECONSIDERATION
AFTER FINAL REJECTION

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Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

November 13, 2007

SIR:

In response to the Office Action mailed August 10, 2007, Applicants respectfully submit the following arguments for establishing that all of the present claims patentably distinguish over the teachings of the prior art applied in this Office Action mailed August 10, 2007.

Specifically, Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the prior art applied by the Examiner in the Office Action mailed August 10, 2007, that is, the teachings of the U.S. patents to Gerdes, et al., No. 4,719,135, to Huang, et al., No. 3,683,044, and to Tashiro, et al., No. 3,704,229, under the provisions of 35 USC 103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a fuel system as in the present claims, having the coating layer as recited in claim 1, the coating layer being

formed by coating an epoxy resin composition comprising (a) an epoxy resin and (b) an epoxy resin curing agent as principal components, the coating layer having the specified gasoline permeability coefficient, and wherein the epoxy resin includes at least one selected from an epoxy resin having a glycidylamine part derived from metaxylylenediamine, and an epoxy resin having a glycidylamine part derived from 1, 3-bis(aminomethyl)-cyclohexane; wherein the epoxy resin curing agent comprises a reaction product of the following (A) and (B) or a reaction product of the following (A), (B) and (C):

(A) metaxylylenediamine or paraxylylenediamine;

(B) a multifunctional compound having at least one acyl group which can form an amide group part by reacting with polyamine to form a oligomer, the multifunctional compound being selected from the group consisting of acrylic acid, methacrylic acid, and derivatives of acrylic acid, methacrylic acid, maleic acid, fumaric acid, succinic acid, malic acid, tartaric acid, pyromellitic acid and trimellitic acid; and

(C) monovalent carboxylic acid having 1-8 carbon atoms and/or a derivative thereof,

and wherein the coating layer contains the skeletal structure of formula (1), at least in an amount of 30% by weight based on the weight of the coating layer. See claim 1.

In the following arguments, the primary focus will be on the amount of the skeletal structure of formula (1), contained in the coating layer. As emphasized further infra, it is respectfully submitted that the combined teachings of the applied references, including the primary reference of Gerdes, et al., would have neither taught nor would have suggested such a fuel system as in the present claims, having

the specified coating layer, with the coating layer containing the skeletal structure of formula (1) at least in an amount of 30% by weight based on the weight of the coating layer. However, Applicants are not relying solely on such amount, and, as can be seen in comparing teachings of the applied references with the presently claimed subject matter, discussed hereinafter, the teachings of the applied references would have neither disclosed nor would have suggested the combination of features as in claim 1 and discussed in the foregoing.

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such fuel system as in the present claims, having features as discussed previously in connection with claim 1, and additionally wherein the gasoline permeability coefficient is 0.2g•mm/m^2•day or less (see claim 2); and/or wherein the epoxy resin composition cured to form the coating layer includes the epoxy resin as in claim 6; and/or wherein the multifunctional compound (B) reacted in forming the epoxy resin curing agent is that set forth in claim 8; and/or area rate of the coating layer formed on the fuel vessel body, as in claim 9; and/or materials of the fuel vessel body or fuel vessel or molded part bodies, as in claims 10-14; and/or wherein the fuel system includes a tube body as in claim 15, with material of the tube body as in claim 16, especially with blending proportions of the epoxy resin curing agent to epoxy resin as in claim 17; and/or wherein the coating layer is formed on at least one of the connected parts as in claim 18; and/or reaction mole ratio of components of the curing agent as in claim 19; and/or blending proportion of epoxy resin curing agent to epoxy resin as in claim 20; and/or thickness of the coating layer as in claim 21; and/or wherein the multifunctional compound reacted in forming the curing agent, is selected from the group consisting of the derivatives set forth in claim 1 (see claim 22).

The present invention is directed to a fuel system which includes at least one of various components such as, for example, a fuel vessel, molded parts for the fuel vessel and a tube for a fuel. In particular, the present invention is directed to such fuel system having excellent performance in preventing permeation of, e.g., gasoline, while having good heat resistance and impact resistance.

In recent years, use has been made of thermoplastic resins in fuel systems, as compared with use of metal, providing advantages of a reduction in weight, prevention of rust, ease in molding and ability to be recycled. However, in previously proposed fuel systems, various performances, such as heat resistance, water resistance, impact resistance, and avoidance of permeation of gasoline, has not been sufficiently satisfactory.

Against this background, Applicants provide a fuel system excellent in gasoline barrier property, heat resistance and impact resistance, and which also (when used in forming a tube of, e.g., rubber) has excellent flexibility. Moreover, the fuel system can be provided at relatively inexpensive cost, insuring a high profitability. Applicants have found that by forming the fuel system utilizing a thermoplastic resin and/or a rubber as the body of the fuel system, and providing a coating layer on at least one side of the body, the coating layer being formed by curing an epoxy resin composition including a specified epoxy resin and a specified epoxy resin curing agent, the coating containing a specified amount of the skeletal structure of general formula (1), as in present claim 1; and wherein the coating layer has a gasoline permeability coefficient of 2 g·mm/m^2·day or less at 60°C in a relative humidity of 60%RH, objectives according to the present invention are achieved. In particular, an excellent gas barrier property is achieved, the fuel system has excellent heat and impact resistance, the coating layer has excellent adhesiveness

to the body of thermoplastic resin, and the fuel system can be provided relatively inexpensively.

In particular, as described on pages 17, 18, 23 and 24 of Applicants' specification, by utilizing the specified epoxy resin curing agent, and epoxy resin, in the epoxy resin composition cured to form the coating layer, the coating layer having at least 30% by weight (of the total weight of the coating layer) of the skeletal structure of general formula (1), as in the present claims, a good adhesiveness of the coating layer to various materials, high gasoline barrier property, flexibility and heat resistance are achieved.

Note, e.g., the paragraphs bridging pages 18 and 19, and 19 and 20, of Applicants' specification.

Note that the multicomponent compound of (B) and the monovalent carboxylic acid of (C) respectively include compounds having at least one acyl group which can form an amide group part by reacting with polyamine to form an oligomer, the multifunctional compound being selected from a specified group of acids and derivatives, and monovalent carboxylic acids having 1-8 carbon atoms and/or a derivative thereof. As for these components (B) and (C), note the paragraph bridging pages 23 and 24, as well as the sole full paragraph on page 24, of Applicants' specification, describing illustrative specific materials as well as the derivatives.

Gerdes, et al. discloses a coated polymeric article, e.g., a polyethylene substrate, having reduced permeability for fuels, particularly gasoline-type fuels, and characterized by a two component, preferably three component, varnish coat comprising: (a) an epoxy resin, e.g., preferably having an epoxy equivalent weight of about 150-280, (b) an effective amount of a specified amine-based curing agent as

set forth in lines 3-11 of column 2, and preferably a third varnish component which is a flexibilizer, e.g., a suitable amount of isocyanate prepolymers, e.g., one based on an isocyanate prepolymer containing ether groups and urethane groups. Note the paragraph bridging columns 1 and 2 of this patent. See also column 2, lines 37-41. This patent discloses that suitable epoxy resins are those containing more than one epoxide group, e.g., 1.5-5, in the monomeric unit. See column 2, lines 56-58. Note also column 2, lines 59-68, for particularly suitable epoxy resins. Note also column 3, lines 1-35, for curing agents for use in forming the fuel impervious polymeric article of Gerdes, et al.

It is respectfully submitted that Gerdes, et al. requires an amine-based curing agent as set forth in column 2, lines 1-11; and it is respectfully submitted that this reference does not disclose, nor would have suggested, structure as in the present claims, wherein the epoxy resin composition cured to form the coating layer includes an epoxy resin curing agent as in the present claims, comprising a reaction product of (A) and (B) or reaction product of (A), (B) and (C), or wherein the coating layer has the recited gasoline permeability coefficient, or other features of the present invention, including the epoxy resin and skeletal structure of general formula (1) of the coating layer (much less the amount of skeletal structure of general formula (1) in the coating layer).

The contention by the Examiner, that the recitation of "the acrylic acid derivative being a derivative that can form an amide by reacting with polyamine to form an oligomer is given little patentable weight as it is directed to a process limitation rather than a structural limitation" (see the last four lines on page 3 of the Office Action mailed August 10, 2007), is respectfully traversed. It is respectfully submitted that this recitation referred to by the Examiner is a property or

characteristic of the acrylic acid derivative, and is not directed to a process limitation rather than a structural limitation. It is respectfully submitted that the Examiner must give full weight to the recitation of the multifunctional compound having at least one acyl group which can form an amide group part by reacting with polyamine to form an oligomer; and that the teachings of the applied prior art would have neither disclosed nor would have suggested such feature of the present invention.

Applicants respectfully traverse the contention by the Examiner in the first paragraph on page 4 of the Office Action mailed August 10, 2007, that the claimed formula (1) would be contained in an amount of 30% by weight, in the structure of Gerdes, et al. As will be shown in the following, in connection with the structure of the Example in Gerdes, et al., set forth in column 5 thereof, the claimed formula (1) would be contained in an amount much less than 30% in Gerdes, et al. In other words, it is respectfully submitted that Gerdes, et al. would have neither disclosed nor would have suggested the structure of the present claims, including wherein the coating layer contains the skeletal structure represented by formula (1) in an amount of 30% by weight or more based on the weight of the coating layer.

Thus, the varnish formulation actually taught in the Example of Gerdes, et al. contains the following ingredients:

(A) 59 parts by weight of epoxy resin;

(B) 7 parts by weight of flexibilizer; and

(C) 34 parts by weight of a mixture of:

7.79 parts by weight of 3-aminomethyl-3 ,5,5 trimethylcyclohexylamine (diamine 1),

6.38 parts by weight of a mixture of 2,2,4- and 2,4,4-trimethylhexamethylenedamine (diamine 2),

5.67 parts by weight of epoxy resin,

1.70 parts by weight of salicylic acid, and

12.46 parts by weight of benzyl alcohol.

The molecular weight is 170 for diamine 1 ($C_{10}H_{22}N_2$), 158 for diamine 2 ($C_9H_{22}N_2$), and 136 for xylylenediamine ($C_8H_{12}N_2$).

If xylylenediamine is used in place of the diamines 1 and 2 in the same molar amounts, the varnish formulation contains the following ingredients.

(A) 59 parts by weight of epoxy resin;

(B) 7 parts by weight of flexibilizer; and

(C) 34 parts by weight of a mixture of:

6.23 parts by weight ((7.79/170) x 136) of xylylenediamine in place of the diamine 1,

5.49 parts by weight ((6.38/158) x 136) of xylylenediamine in place of the diamine 2,

5.67 parts by weight of epoxy resin,

1.70 parts by weight of salicylic acid, and

12.46 parts by weight of benzyl alcohol.

Letting the varnish formulation consist of only the epoxy resin and the amine curing agent for simplification, the content of the claimed formula (1) is calculated as 17% by weight (12/(12 + 59) x 100), which is far lower than the claimed range of 30% by weight or more. It should be noted that the content in the actual formulation in the Example in Gerdes, et al. would be smaller than 17% by weight, because of the presence of other ingredients.

Thus, the content of the claimed structure (1) actually taught by Gerdes et al. is much smaller than the presently claimed range. It is respectfully submitted that

Gerdes, et al. would have neither taught nor would have suggested, and in fact would have taught away from, amount of skeletal structure of general formula (1) as in the present claims.

It is respectfully submitted that the additional teachings of the secondary references as applied by the Examiner would not have rectified the deficiencies of Gerdes, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Tashiro, et al. discloses epoxy resin compositions having room temperature curability, the curing agent being sufficiently curable even in a wet state and having an improved compatibility with tar. The curing agent disclosed in this patent can be obtained by addition and condensation reactions of three components A, B and C, A being an acrylic or methacrylic acid ester, B being one of slightly water-soluble or insoluble aliphatic amines having a primary amine radical or an amine mixture thereof, and C being (a) a xylylenediamine having a specified structural formula and having both properties of aliphatic amine and aromatic amine, and (b) a 70:30 mixture of metaxylylenediamine and paraxylenediamine. See column 1, line 59 though column 2, line 16. Note also column 2, lines 17-49, describing how the components A-C of the curing agent are reacted.

Huang, et al. discloses a heat-curable resinous composition comprising polyglycidyl xylylenediamine, obtained by the reaction between xylylenediamine and epichlorohydrin. This patent document discloses that the disclosed material has a relatively low viscosity resulting in a good workability, and gives cured products exhibiting a high heat distortion temperature. Note column 1, lines 6-9 and 61-67. Note also column 4, lines 21-25. Huang, et al. discloses that the polyglycidyl xylylenediamine can be readily cured with the aid of curing agents customarily used

for curing of glycidyl compounds, such as aliphatic or aromatic polyamines and organic carboxylic anhydrides. Note column 4, lines 37-41. This patent further discloses that the polyglycidyl xylylenediamine provides an industrial material exhibiting a low viscosity suitable for adhesive and casting, and a cured product prepared therefrom shows a high heat resistance. See column 5, lines 19-25.

Initially, it is respectfully submitted that the teachings of Gerdes, et al., as applied by the Examiner, would not have been properly combinable with the teachings of Tashiro, et al., or Huang, et al. Thus, it is noted that Gerdes, et al. is directed to a fuel impervious polymeric article, facing the problem of providing such article without a primer or adhesion promoter. In contrast, Tashiro, et al. is directed to an epoxy resin curing agent which is sufficiently curable even in a wet state and having an improved compatibility with tar. Huang, et al. is directed to a heat-curable resin compositions comprising polyglycidyl xylylenediamine, with a relatively low viscosity and high heat distortion temperature, suitable for adhesives and coatings, without disclosure of whether or not the composition is permeable to fuel. It is respectfully submitted that Tashino, et al., and Huang, et al. are silent as to the structures formed having fuel barrier properties. In view of differences in technology in the teachings of the applied references, and further in view of differences in problems addressed by each of these references, it is respectfully submitted that one of ordinary skill in the art concerned with in Gerdes, et al. would not have looked to the teachings of Tashiro, et al. or of Huang, et al. In other words, it is respectfully submitted that the teachings of these references are directed to non-analogous arts.

In any event, particularly in view of the differences in technology in the teachings of the applied references, and also in view of differences in problems addressed by each, it is respectfully submitted that there would have been no proper

reason to combine the teachings of these applied references, as applied by the Examiner. Absent such reasons, it is respectfully submitted that the combination of teachings of these references as applied by the Examiner is improper under the guidelines of 35 USC 103, using impermissible hindsight.

In any event, even assuming, arguendo, that the teachings of Gerdes, et al., Tashiro, et al., and Huang, et al. were properly combinable, it is respectfully submitted that such combined teachings would have neither disclosed nor would have suggested the presently claimed invention, including, in addition to the recited epoxy resin curing agent, wherein the coating layer includes an epoxy resin comprising at least one selected from an epoxy resin having a glycidylamine part derived from metaxylylenediamine or from 1,3-bis(aminomethyl)cyclohexane, or the coating layer having the specified curing agent, or the skeletal structure of general formula (1) in the coating layer, especially amount thereof, and advantages achieved thereby.

As acknowledged by the Examiner in the last line on page 2 of the Office Action mailed August 10, 2007, Gerdes, et al. fails to disclose, inter alia, an epoxy resin having a glycidylamine part derived from metaxylylenediamine. It is respectfully submitted that the other applied references also fail to teach epoxy resins having a glycidylamine part as in the present claims. Thus, Tashiro, et al. fails to teach the claimed glycidylamines, describing glycidyl ethers derived from bisphenol A, for example.

On page 5 of the Office Action mailed August 10, 2007, the Examiner contends that Applicants argue that Toshiro, et al. fails to disclose the claimed glycidylamine, describing glycidyl ethers derived from bisphenol A, for example; but that as neither glycidyl ether, or bisphenol A, is claimed, it is unclear how glycidyl

ether or bisphenol A defines the presently claimed invention. However, it is respectfully submitted that the Examiner has mischaracterized Applicants' contention. That is, Applicants contend that Toshiro, et al. describes glycidyl ethers derived from bisphenol A, for example. Toshiro, et al. does not disclose the presently claimed glycidylamine. It is respectfully submitted that the teachings of Toshiro, et al., describing glycidyl ethers derived from bisphenol A, for example, would have neither disclosed nor would have suggested the presently claimed subject matter, including use of the presently claimed glycidylamine.

It is emphasized that glycidyl ether or bisphenol A is not recited in the present claims, but glycidyl ethers derived from bisphenol A are described in Toshiro, et al. Such description in Toshiro, et al. would have neither taught nor would have suggested the presently claimed subject matter, including use of the presently claimed glycidylamine.

The Examiner has relied on Huang, et al. as disclosing polyglycidyl xylylenediamines. However, it is respectfully submitted that Huang, et al. does not disclose gasoline barrier properties of the cured products. Taking the teachings of the applied prior art in combination, it is respectfully submitted that there would have been no disclosure, nor any suggestion, of the superior gas barrier properties of the presently claimed coating layer, having, inter alia, the epoxy resin comprising at least one selected from an epoxy resin having a glycidylamine part derived from metaxylylenediamine and an epoxy resin having a glycidylamine part derived from 1,3-bis(aminomethyl)-cyclohexane, as in the present claims.

In the paragraph bridging pages 4 and 5 of the Office Action mailed August 10, 2007, the Examiner mischaracterizes Applicants' argument, the Examiner stating that Applicants argue that Toshiro, et al. and Huang, et al. "disclose fuel

permeability and barrier properties". However, this is not Applicants' argument. That is, Applicants argue that Toshiro, et al. and Huang, et al. are silent with respect to fuel barrier properties of the materials described therein. Absent disclosure of fuel barrier properties, and emphasizing that Gerdes, et al. provides structure having fuel barrier properties, it is respectfully submitted that one of ordinary skill in the art concerned with in Gerdes, et al. would not have looked to the teachings of Toshiro, et al. or Huang, et al.

In view of the foregoing comments, and again noting the calculations herein showing that the Example of Gerdes, et al. would have far lower than the claimed range of 30% by weight or more of skeletal structure of formula (1) in the coating layer, entry of this Request for Reconsideration, and reconsideration and allowance of all claims presently in the application, are respectfully requested.

Applicants request any shortage in fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case 396.42795X00), and credit any excess payment of fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

By _____
William I. Solomon
Registration No. 28,565

WIS/ksh
1300 N. Seventeenth Street
Suite 1800
Arlington, Virginia 22209
Tel: 703-312-6600
Fax: 703-312-6666